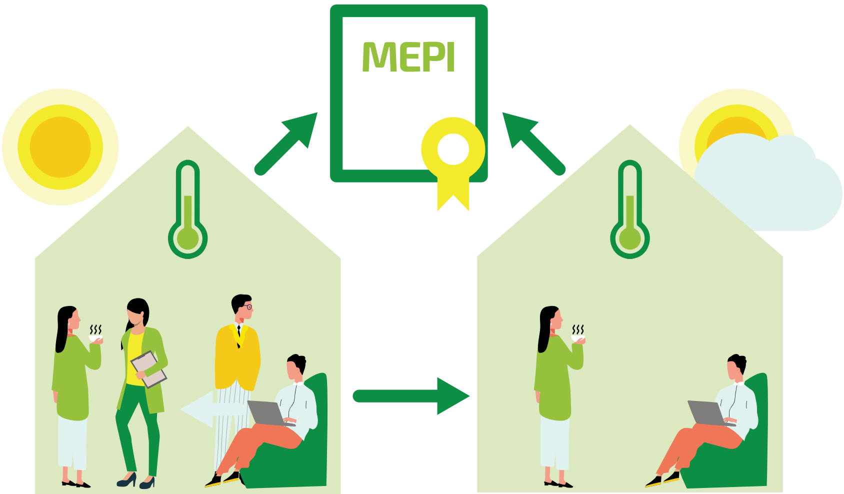
X-tendo

INTRODUCTORY REPORTS

REAL ENERGY CONSUMPTION

MARCH 2021



ACTUAL MEASURED ENERGY

STANDARD CONDITIONS OF CLIMATE & USE CORRECTED

EXPECTED ADVANTAGES

- Improved **accuracy**
- Augmented **user acceptance**
- Simplified **procedures**
- Increased **market trust**
- Enhanced **renovation advice**
- Improved **policy instruments**

THE REAL ENERGY CONSUMPTION INDICATOR IS A METHOD TO DETERMINE THE ENERGY PERFORMANCE OF A BUILDING BASED ON MEASURED ENERGY USE. MEASUREMENTS OF FINAL ENERGY DELIVERED PER ENERGY CARRIER AND FOR DIFFERENT APPLICATIONS, TOGETHER WITH ELECTRICAL ENERGY EXPORTED, ARE TRANSLATED INTO AN INDICATOR EXPRESSING THE TOTAL ANNUAL PRIMARY ENERGY CONSUMPTION AND THE RENEWABLE ENERGY RATIO OF THE BUILDING AT STANDARD CONDITIONS OF CLIMATE AND USE. IT CAN BE IMPLEMENTED AS A STANDALONE METHOD OR IN ADDITION TO EXISTING ENERGY PERFORMANCE CERTIFICATE (EPC) CALCULATIONS.

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WHY WE DEVELOPED THIS FEATURE

The gap between real energy performance and EPC-calculated performance can be significant and is a source of confusion for EPC users. Methodologies that integrate on-board monitoring data and diagnose the difference between measured and calculated energy use (e.g. to adjust for real weather or occupant conditions) aim to explain the difference between the measured and calculated energy use to increase trust in the EPC. The inclusion of real energy use data also enables automation of procedures and simplification of on-site inspections. The improved accuracy and better link with meter readings and billing information enhance user acceptance. Energy performance improvement measures can be better tailored to the specific building, augmenting the quality of renovation advice. It is anticipated that this will lead to increased market trust and trigger more investments in building energy renovations. Furthermore, a better link with measured energy use will improve policy instruments and targeted policy measures for monitoring and improving the energy performance of the building stock.

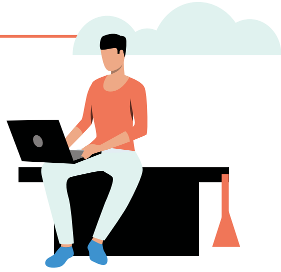
SCOPE OF APPLICATION

The real energy consumption indicator can be included in EPCs for all types of buildings. Specific aspects related to the building type may require additional points of attention (e.g. on energy usage) and/or require different applications to differentiate metered energy by its use.

For existing buildings, the operational performance is valuable information that can serve in addition to existing energy performance indicators or as a standalone indicator. For new or renovated buildings, a period after commissioning is required to obtain the necessary input data. Historical energy use data may be less helpful as a reference in assessing the real performance of existing buildings where the use profile varies, especially those with variable/limited numbers of occupants such as single-family dwellings or rental dwellings with frequently changing residents. For some buildings, like residential or small offices, compliance with privacy legislation may require additional attention. In the case of public buildings accommodating governmental organisations, deployment of EPC schemes may have higher priority or may be subject to more stringent performance levels because these organisations are expected to set an example, facilitating the introduction of a method based on measured energy use.

Building typology	New and existing buildings • Residential (single-family, multi-family) • Non-residential (offices, commercial, industrial) • Public (administrative, education, health, heritage)
Tenure	Owner-occupied, co-operative, private rental, public rental
Property status	Renovating, renting, selling, buying

LEVEL OF EXPERTISE, SKILLS AND TRAINING

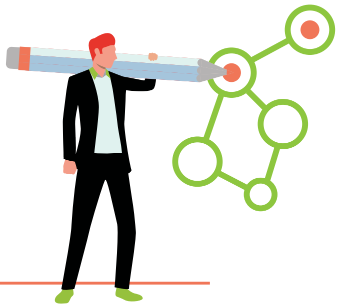


Depending on the methodology applied (simple building level, detailed building level, stock model development), the level of expertise, skills and training varies from intermediate to expert. Calculating the real energy consumption needs the input of basic information that can be gathered from different sources, e.g. energy bills, and that may require limited pre-processing. Basic reading, writing, calculation and computer operation skills are required. In addition to these basic competences, a limited training of half a day should be sufficient to get acquainted with the basics of the methods. If energy use data is not available, a measurement period of at least 12 months should be factored in to determine the average energy use of the building. The detailed building level approach or stock model development should be executed by a certified expert, namely an engineer or mathematician/statistician with expert knowledge on building energy performance modelling or statistical modelling. This kind of analysis is time-consuming and is not elaborated within X-tendo.

	Fundamental awareness (basic knowledge)	**Novice** (limited experience)	**Intermediate** (practical application)	**Advanced** (applied theory)	**Expert** (recognised authority)
Building level method			✓		
Detailed method					✓
Stock model method					✓

GOOD PRACTICES

Transparency schemes for building energy performance on the basis of measured energy use can be effective. There is compelling evidence from the US (The Energy Star rating scheme's Portfolio Manager building energy performance benchmarking system) and Australia (NABERS; National Australian Built Environment Rating System) . NABERS ratings have significantly increased on average since the scheme was introduced, and research shows a correlation between an increase in NABERS energy rating and increased property value, reduced vacancy rates and increased rental value.



METHODS AND ASPECTS INCLUDED

The assessment method is based on the EPC method (operational rating) as implemented in Sweden, further aligned with the overarching standards of the Energy Performance of Buildings Directive (EPBD) and extended with optional modules to allow for accurate inter-building comparison. The method requires the input of measured space heating, space cooling, domestic hot water and other energy uses, separately and per energy carrier, while excluding non-EPC related energy use. Only the domestic hot water use monitoring can be replaced by using a calculation model, if its associated energy consumption cannot be separated from other uses of the same energy source. The output is an energy performance indicator for real energy use, representing the yearly specific primary energy use of the building. The output also includes yearly CO_2 emissions and, optionally, the renewable energy ratio.

To enable inter-building comparison, the measured energy use is corrected so that it represents standard conditions of climate and use. This correction procedure takes by default the following aspects into account:

- **Size of the building unit** (useful/reference floor area)
- **External weather conditions** (heating and cooling degree days method)
- **Energy carrier** (primary energy factors)

The correction is optional for:

- Indoor thermal environmental conditions
- Service provision (domestic hot water energy delivery)

HOW WE WILL IMPLEMENT IT

The method requires the presence or installation of measurement infrastructure on the level of building (unit) for monitoring the various energy components, with submetering depending on the system configuration and the number of building units, and sensors for indoor air temperature for inter-building comparison. Alternatively, in its simplest form, the input is limited to the annual total energy use per energy carrier, the building (unit) type and the useful floor area. Where these simpler inputs are used, we outline potential options for incorporating this information within EPCs, such as normalisation approach, together with the difficulties and potential solutions. In the monitoring and accompanying data handling, data protection and security must be ensured and General Data Protection Regulation (GDPR) requirements respected.

In deciding whether to include real energy consumption in the EPC assessment in individual Member States, we suggest carrying out a preliminary cost-benefit analysis at the national level, taking into account the infrastructure that is present in the building stock, the potential reuse of it and the feasibility and cost burden of introducing the new procedures.

OVERALL EVALUATION

LESSONS LEARNT

- Methods and indicators identified as suitable for including real energy use in EPCs are selected based on literature review and expert consultation.
- SWOT analysis shows promising balance to the positive side.
- Swedish example demonstrates successful implementation.

PREREQUISITES

- A minimum 12-month duration of the measurement period.
- Measurement infrastructure is required. Advantage if smart metering infrastructure is foreseen.
- Insights on context (e.g. existing building stock, legal boundaries) are required for cost-benefit evaluation of the method in a given region.

REPLICATION

- Method development for benchmarking and setting requirements is necessary per building type, e.g. residential, office.
- Some country-specific complicating issues may be expected, e.g. related to legal aspects (e.g. access to and use of energy use data).
- Proprietary and diverse communication protocols may affect broad replication (e.g. building energy monitoring and management systems facilitating interoperability and connectivity).

PROS

- Clear and simple for building owner.
- Improved tailored renovation advice including cost-benefit analysis.
- Opportunities for automation, simplification of procedures and improvement of instruments (calculation methods, policy monitoring).

CONS

- To enable correct inter-building comparison, correction of the measured energy use to standard user behaviour is required, but not easily attained.
- Some parts of methodology may still need modelling, e.g. domestic hot water use.
- For the design, calculation is still required.

RISKS

- GDPR (e.g. data privacy)
- Citizen data security (e.g. cybersecurity risks).
- Fraud (e.g. manual meter readings, bulked energy carrier quantification)

RECOMMENDATIONS

- To enable certification based solely on real energy use and limit the use of models, sufficient infrastructure for monitoring should be included.
- If a method based on real energy use is applied in addition to another method (used for certification), it may have the highest effectiveness/cost ratio in terms of user acceptance and motivation.

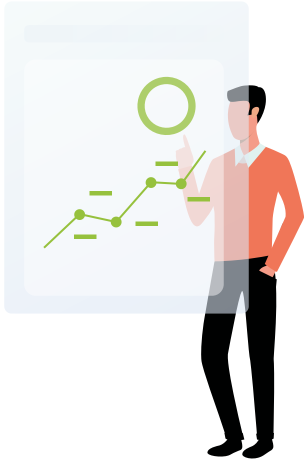
NEXT STEPS

- Further detail the methodology (e.g. options for inter-building comparison) and the guiding documentation.
- Include advice to implementing bodies to iteratively finetune the approach.
- Test the approach on a variety of buildings and regions within EU and further finetune and tailor the approach based on the experiences.

COMPLEXITY

- Specific skills are required to separate EPC energy uses from other uses supplied by the same energy sources (e.g. space heating from domestic hot water and/or cooking, lighting from electronics).
- Specific national or regional building stock characteristics are required for different building categories (functional differentiation) as an input in the method (e.g. atypical uses or uses not covered in EPC) and for further development of requirements and benchmarks.

COMPLIANCE WITH CROSS-CUTTING CRITERIA



QUALITY AND RELIABILITY OF EPCS

Overall good quality and reliability of EPCs can be expected. The real energy consumption indicator would reduce confusion about the energy performance gap. Guidelines, clear definition of parameters and method transparency are provided. Setting hard requirements is difficult (because of correction for user influence and some specific difficulties such as bulked energy carrier quantification).

USER-FRIENDLINESS

Overall good to very good user-friendliness can be expected, with more comprehensive information and links with billing information. For example, the information in the end-user results would include both the (uncorrected) measurement data and the energy use corrected to standard conditions of climate and use. Sufficient guidance/transparency is foreseen to interpret/deploy the method. A description is provided of the formula structure of the calculation procedure. For each of the input parameters, a description is included of the method used to gather the information.

CONSISTENCY WITH STANDARDS

The method and roll-out procedures for future deployment are consist with CEN/ISO standards. The determination procedure is developed taking into account the relevant standards, starting from the EPBD overarching standard EN 52000-1: 2017 and the underlying set of standards.

ECONOMIC AND POLITICAL FEASIBILITY

Method, options and required infrastructure are selected taking the estimated cost-effectiveness ratio into account. The selection is based on literature review and expert consultation (experience-sharing web-calls with representatives of national implementing bodies and research institutes as well as interviews with international experts on the topic (IEA annex 58 and 71)). Several Member States already mention the relevance of this indicator for future policies.

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#Xtendoproject

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